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TABLE OF CONTENTS

THE NON-OPERATIVE TREATMENT OF SCOLIOSIS. Walter Truslow, M. D., Brooklyn, N. Y. 121

CHRONIC CIRCUMSCRIBED OSTEOMYELITIS. Dr. Walter G. Stern, F. A. C. S., Cleveland, Ohio 132

OSTEOMYELITIS FOLLOWING WAR INJURIES. (Based on the Study of 61 Cases.) Richmond Stephens, M. D., New York City 138

A PROTRACTOR FOR MEASURING ROTATION OF JOINTS. William Arthur Clar, A. M., M. D., Pasadena, Calif. 154

GIANT-CELL TUMOR IN THE KNEE JOINT: REPORT OF A CASE. Pio Bianco, M. D., Rochester, Minn. 156

GILLETTE, ARTHUR J. St. Paul, Minn. Obituary 158

ORTHOPAEDIC TITLES IN CURRENT LITERATURE 161

NOTES AND NEWS 164

AMERICAN ORTHOPEDIC ASSOCIATION PROGRAM 165

CURRENT ORTHOPAEDIC LITERATURE 168

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Vol. 3, No. 4 APRIL, 1921 Old Series Vol. xix. No. 4

The Journal *of* Orthopædic Surgery

THE NON-OPERATIVE TREATMENT OF SCOLIOSIS

BY WALTER TRUSLOW, M. D. BROOKLYN, N. Y.

In approaching what is perhaps the most difficult problem in Orthopedic practice, one would wish to be clear in defining the subject. This paper will deal with true rotary lateral curvature of the spine—that is, with the well-known deformity, with structural changes. Functional scoliosis must be dealt with carefully and thoroughly, but is not the bete noir that structural scoliosis is.

It is necessary also to understand just what one may expect to accomplish, and not to pre-suppose what at present seems impossible. Successful treatment of rotary lateral curvature of the spine contemplates (1) stopping the deforming process, (2) materially lessening existing deformity, and (3) reasonably assuring the non-return of the deformity. The present writer agrees with the findings of the recent Scoliosis Committee of the American Orthopedic Association, which stated that no known method had yet been found to restore to body symmetry a structural scoliosis; but he believes that the ends just outlined are worth striving for and are attainable.

Every case must be considered individually; but, in general, the non-operative treatment of structural scoliosis consists in a careful weighing of the indications for and the proper use of (1) corrective plaster-of-Paris jackets, with pressure paddings and negative window spacing, and (2) of specific intensive exercises, with retention brace or corset—often an alternating use of these means. We usually state our procedure in treating deformities, thus: "Correct the deformity first, then insure its non-recurrence." Practically, in the deformity under discussion, we find no means completely to correct the deformity, and I think that most of us agree that there is a very definite limit to the forces

which we can exert on the individual patient. So it has long appeared to the writer that the one who assumes professional charge of these patients should outline a procedure which should allow the use of both means, and that he should demand for himself reasonable freedom of decision as to when either should be used. Practically, in the writer's hands an alternation of the plaster corrective jackets and of the retention-muscle training has often been most effective.

But it is insisted that the judgment of the one in charge must be formed and controlled, not only by his observation of the patient's varying general condition, but particularly by a system of measuring of the specific elements of deformity which should be reasonably accurate and yet so easily applied as to be used at each change of plaster-of-Paris jacket and at monthly intervals while the intensive exercises are being taken.

After first hunting for and eliminating, if possible, unequal lengths of legs and congenital bone asymmetries, the writer finds the following elements of deformity necessary to record at regular intervals:

1. Deviation of the spine, standing.
2. Relative carriage of shoulders, standing.
3. Relation of lateral upper trunk lean to a spinal perpendicular, standing.
4. Deviation of spine, in prone lying.
5. Rotation of spine, in prone lying.

They can be recorded in from five to ten minutes, and the succeeding records, rightly studied, are exceedingly valuable. The patient stands with back exposed from neck to buttocks' fold. A strip of adhesive plaster is placed over the spinous processes, from seventh cervical to first sacral (at top of buttocks' fold); the successive spinous processes are palpated and marked on the adhesive plaster; the level of right and left scapular angles are projected and marked on the margins of the adhesive plaster. A plumb line, representing the "sacral perpendicular," is then hung in such a manner that its weight will be opposite the buttocks' fold and the upper end to right or left of the seventh cervical marking. Where the string is opposite the seventh cervical point, a mark is made on the adhesive plaster. To make a permanent record of this, the adhesive plaster is transferred from the pa-

tient's back to any flat surface, and the following lines drawn and distances measured. A line is drawn, with ruler guide, from seventh cervical to first-sacral dot. It is called "spinal height." A line is drawn from it to the dot, representing greatest dorsal deviation; another to greatest lumbar deviation. Either marking, for scapular angle, is projected across the adhesive strip, to get its level relative to that of the opposite scapular angle. Measurements are taken as follows:

a. of dorsal deviation.

b. of lumbar deviation.

c. of spinal height.

d. of relative scapular levels.

e. of projection, to right or left, of seventh cervical vertebra to sacral perpendicular.

A history sheet record of the above reads, for example:

Spine, standing;

Spinal deviation $\frac{3.2 + 1.5 -}{45} = .1044$ or $10\frac{1}{2}\%$

Carries left shoulder 3.3 lower.

Carries 7th cervical 1.6 to the right.

The above is a record of certain elements of deformity in standing or weight-bearing posture.

To obtain a record of bony changes, weight-bearing must be eliminated. The patient is placed in a standard position prone upon a table. Another strip of adhesive plaster is used upon the exposed back from seventh cervical to buttocks' fold. Successive spinous processes, from seventh cervical to first sacral, are palpated and marked. Rotations in degree are obtained by the use of the writer's rotatometer. This consists of two hinged arms, with a recording sector fixed to one, and an indicator fixed to the other. The arm with the fixed sector is placed across the back, at the position of greatest dorsal rotation. It takes such tilt to the horizontal as this back transverse may give it. The arm with the index has also a spirit level. This arm is moved up and down until it is levelled, and the degrees of rotation are read as at the place which its index takes on the sector of the other arm. The greatest lumbar rotation (sector arm tilted in

the opposite direction) is taken in the same way. The adhesive strip is transferred, and is ruled and measured for spinal height and for dorsal and lumbar deviations, as when taking these measurements with the patient in the standing position. The history sheet record of these measurements would read, for example:

Spine, prone;

Spinal deviation $\frac{2.2 + 1.1}{45} = .0733$ (or 7⅓%)

Rotations, 8 degrees and 5 degrees.

Comparison of the relative measurements of the standing and of the prone positions, of the amount of self-correction possible and of the examiner's correction is an aid to prognosis, but is particularly important in determining how effective is the treatment, and what feature of deformity correction must be emphasized in continuing treatment.

Details of the plaster-of-Paris corrective jacket will not be dealt with at this time. Effective methods of procedure are well known. Each surgeon must use that which he knows best. But some features of technique seem worth emphasizing. First, one must have a very clear idea of the elements of deformity to be corrected. The writer finds it more effective to depend upon the application of the jacket to correct the faulty upper trunk-lean and the low shoulder, and upon the exact placing of subsequent paddings to correct the spinal deviations and the rotations; rather than to emphasize the correction of all deformity elements by the position of the patient upon which the jacket is built. To this end the hips-flexed prone lying position upon the hammock in the frame is chosen. Before plaster dressings are applied, the pelvis is fixed and then the upper trunk is stretched longitudinally and in such a manner laterally as to carry faulty upper trunk-lean across to the opposite side and to lift the low shoulder. This, of course, lessens spinal deviation and, to a slight extent, rotation; but the emphasis is placed upon the faulty upper trunk-lean and the low shoulder. Having in consideration proper counter pressures, when paddings shall be used, care is taken that the transverse of the shoulders shall be in the same plane as the transverse of the pelvis. This and succeeding plaster jackets are distinctly corrective, but pressure forces are to be made quite within the limit of comfort.

Negative window spaces are cut out and first paddings to correct spinal deviation and rotation are applied in two weeks. Succeeding paddings are applied once a week to six weeks from the application of the plaster jacket. During that period the plaster rigidity itself prevents any further correction in the faulty upper trunk-lean and in the low shoulder; but much correction of the spinal deviations, of the rotation and of the anterior rib deformities may be obtained. The writer emphasizes this point, as he believes that hazy understanding of it accounts for indifferent success.

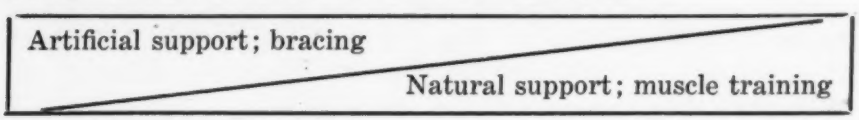
The appointment for the application of the second corrective jacket must allow sufficient time to take the measurements, to apply the plaster body mould (a rear half is sufficient), from which a cast is to be made for the retention brace or corset, and then to apply the second corrective jacket. The patient's position for the plaster mould for the brace cast is also hips-bend prone and with over-correction of the faulty upper trunk-lean and with levelled shoulders. The position for the second corrective jacket is hips-bend prone with marked over-correction of the faulty upper trunk-lean and with over-correction of the low shoulder. Its program of four to six weeks is similar to that of the first corrective jacket. It has been applied in greater length, to meet natural growth plus spinal lengthening due to lessening of spinal deviation and spinal rotation. During the wearing of it, further correction of deviation and of rotation and front chest moulding will have been accomplished.

At the end of three months, the figures representing spinal deviation should have been reduced about one-half and that representing spinal height should have been slightly increased. This should reduce the ratio of deviation deformity about one-half, or, for example, a ten per cent deviation deformity should be about five per cent. The upper trunk-lean, as indicated by the relation of seventh cervical vertebra to sacral perpendicular, should have been carried nearly to, or, perhaps, passing across the vertical line; and the shoulders should have been levelled. In this time it is usually possible to reduce the figures indicating rotations also about one-half. Although the correcting forces have been but gradually yet steadily applied, and although the cooler months of the year have been chosen and the "scratcher" faithfully used daily, the patient's skin and the patient's disposition will not tolerate more than three months of these jackets.

What is now to be done? We know that much of the deformity will recur if we do not hold what we have attained and so train the muscles by intensive exercises that they will increasingly be able to assume the task of natural support, with ever lessening artificial support. The brace or corset, planned for at the time of changing the plaster corrective jackets, should now be ready.

A truly retaining brace is difficult to attain, but is important. The requisites are (1) ability to hold correction attained; (2) "fool-proof"—the patient must be able to apply it with reasonable accuracy; (3) extensibility to meet normal growth, and longitudinal extensibility and lateral compressibility to follow further deformity improvement which proper exercises will surely give; and (4) finally, if possible, self-correction. (The writer believes that this last will be possible by the use of a laterally bending upper segment of the brace and a stop-joint to prevent bending in the directions of deformity increase. The mechanical difficulties, however, are such as to make a presentation at this time of what has been accomplished premature). The Knight spinal brace can be modified to meet all of the requisites outlined, except self-correction. The brace must be worn by night as well as by day at first.

With the removal of corrective jackets and with the assumption of the retention brace, the intensive exercises begin. The brace is removed for the exercises only. The patient's back is exposed for all exercises, to observe every detail of movement. The starting positions are in kneeling, on hands and knees, in prone lying, on the back, half prone at end of table and finally sitting, to insure as little erect weight-bearing as possible and because from these positions best concentration on the parts to be exercised is obtainable. The muscles must gradually be trained to assume the responsibility of weight-bearing. As the muscles get stronger and bring the superimposed body segments nearer and nearer to the line of gravity of the body, the artificial support of the brace is less and less used. A simple reinforced corset becomes possible. The relation of artificial support to natural support may be expressed by the schematic diagram:



The exercises are classified as Preliminary and Deformity Correcting. The purpose of the preliminary exercises is:

1. To train the patient to take the starting positions and the simplest variations accurately;

2. To "limber up" the stiffened muscles and ligaments of the trunk, the shoulder girdle and the hip-joints; and

3. To start the correction of the exaggerated antero-posterior spinal curves.

All of the *preliminary exercises* are symmetrical.

I. Kneeling.
   1. With hands on hips; trunk bending forward.
   2. Alternate foot placing forward.

II. On hands and knees.
   1. Alternate head and mid-back raising.
   2. Trunk swaying forward to prone lying, then backward to resting on heels.
   3. Alternate thigh extensions backward to horizontal.
   4. Alternate arm extensions forward.

III. Prone lying.
   1. "Seal"—with hands clasped low behind the back; raise head and shoulders and arms.

IV. Lying on back.
   1. With knees drawn up (feet resting on the floor); bend both knees to the chest.
   2. With arm stretched upward beyond the head; arm flinging forward, raise trunk to sitting, to forward reach to toes.

V. Half prone lying at end of table.
   1. Alternate thigh raising to horizontal (knee straight).
   2. Raising both thighs to horizontal (knees straight).
   3. With arms stretched out at sides; raise head and shoulders and arms.

VI. Sitting.
   1. With feet apart and dumbbell on floor between; raise weight floor to right shoulder, to high, to shoulder, to floor, to left shoulder, to high, to shoulder, to floor.

About a week is sufficient time to give to the preliminary exercises.

The intensive corrective exercises are progressively based on the preliminary exercises. They are asymmetrical. They aim definitely to correct the specific features of the deformity—the upper side trunk-lean, the low shoulder, the compound spinal deviation, the exaggerated antero-posterior curves, and especially the rotations. It is believed that this is accomplished by actively and progressively using the muscles which must be depended upon to maintain these corrections. For clearness of wording, the type—right dorsal left lumbar—is here chosen. Modifications of the following exercises must be chosen in variations from this type.

Intensive *Corrective* (Rotation) *Exercises.*

I. Kneeling.

1. With cane in hands; bend trunk forward to the left, reaching left side of cane far forward to the left, carrying right arm (half bent) sideways upward, with upper trunk twist to the right.

II. On hands and knees.

1. Stretch right thigh backward and left arm forward (synchronous movement).

2. Place left foot forward on the floor and raise right arm sideways upward with upper trunk twist to the right (synchronous movement). (Later).

3. Stretch right thigh far backward, sway trunk backward (to sitting on left heel), raise right arm sideways upward, twisting upper trunk to the right (synchronous movement).

III. Prone lying.

1. With left arm forward (to the left) on the floor, head resting on left arm, and with right arm out sideways on the floor; raise right arm sideways upward with upper trunk-twist to the right.

(Later, with increasing dumbbell weight in right hand).

IV. Lying on back.

1. With knees drawn up (feet resting on the floor); keeping knees parallel, bend toward the chest, twisting so that knees point to the right (feet to the left).

2. With arms over head on the floor; raise trunk to sitting, to left hand touch to left toe and with right arm raising sideways upward and upper trunk twist to the right (synchronous movement).

V. Half prone lying at end of table (feet on floor).

1. With upper trunk placed to the left on the table, left arm reaching far forward to grasp left side of table and right arm stretched out sideways; raise right thigh to horizontal (knee straight) and raise right arm sideways upward (synchronous movement).

(Later, add increasing dumbbell weight in right hand.)

2. (Later) Repeat V. 1, but raising both thighs to horizontal (gradually getting an increasing twist to the low spine, by elevating the left hip and thigh).

VI. Left thigh support sitting on bench—"spring sitting."

1. The left thigh is supported on the bench, the right thigh-leg-foot is stretched far backward, a dumbbell is held at each shoulder; bend trunk forward to the left, reaching left arm forward (over left knee) to the floor, raise right arm sideways upward, with upper trunk twist to the right (synchronous movement).

2. Left hand-support "spring sitting"—The left hand rests on a table far forward, the remainder of the body in spring sitting; raise right arm sideways upward with upper trunk twist to the right.

The above exercises are planned with the least apparatus possible, so that the patient may do them at home daily. Where the operator wishes to keep entire control of all of the exercises in his own gymnasium, much elaboration will suggest itself and such apparatus as the Swedish plinth, stall bars and bom, will add to the effectiveness of much of this. The writer outlines an exercise program as follows: (1) For first month, at office gymnasium once a week, (2) for second month, two office visits, (3) thereafter, once a month at office gymnasium. This is supplemented with a written gymnasium prescription (GR/p.) of daily home exercises, which is added to usually at each visit.

Experience has shown that these exercises are truly corrective and especially of the rotation deformity.

Now, to estimate the relative merits of the three procedures and the amount of time to be given to each:

1. The corrective plaster jacket lessens deformity more rapidly than does brace-wearing or exercises. It affects rotation least of all of the elements of deformity. It has distinct time limitation because of skin-pressure intolerance and because of the patient's attitude toward it. It must be re-assumed after a shorter interval of bracing and exercises in the paralytic spine patient.

2. The retentive brace alone will delay deformity formation. It will bring about no correction of it, and unless constantly cared for, will allow increase in deformity. It is inadequate in the paralytic spine.

3. Exercises alone will not be sufficient to prevent an increase in a deformity in which the ratio of deviation is greater than four per cent. It must be used with very gradual progression in the paralytic. When reinforced by an efficient retention brace and intermitted with an occasional short return to the corrective jacket, it is the best means available for insuring a stopping of deformity progress, for insuring a large amount of deformity lessening, and, by its general hygienic, as well as local effect, for a reasonable assurance of non-return of deformity.

As to time necessary, one would say that a structural scoliosis presenting five per cent deviation or less would require about one year of active treatment—plaster corrective jackets for three months, nine months of retentive brace and intensive supervised exercises; and that in the second year a girl could wear a simpler reinforced corset and do her home exercises daily, with occasional supervision of the doctor. A ratio of deviation of five to ten per cent would require three months of corrective jackets; six months of retentive brace and intensive exercises; three months of corrective jackets, and a second year of bracing and supervised exercises. Greater amounts of deformity would require longer time. The paralytic, if treated non-operatively, must have a larger proportion of the time given to the corrective jacket and must be carried on for several years.

Summary:

1. Successful treatment of structural scoliosis must depend upon a clear understanding of the elements of deformity, and the lessening, if not complete elimination, of all of them.

2. Uniform and regular measurement and numerical record of the elements of deformity are important as guides to continuance of treatment and as indicating elements most needing correcion.

3. A balanced use of corrective plaster-of-Paris jackets, of retention brace and of intensive exercises is essential to satisfactory results.

4. The position of the patient when the plaster jacket is applied is responsible for improving body posture and shoulder carriage; the successive paddings, for care of the spinal deviation and the rotation.

5. Essentials of a retention brace are (a) ability to hold correction attained; (b) application by the patient with reasonable accuracy; (c) extensibility and lateral compressibility to meet normal growth and progressive deformity decrease; (d) mechanical self-correction by the brace seems possible, but not yet fully attained.

6. Gymnastic exercises must be progressive, intensive and with a minimum of erect weight-bearing. They must aim to correct all of the elements of deformity, especially that of rotation. Starting positions other than standing facilitate these ends.

7. Retention of deformity correction attained must be maintained while exercise is developing natural muscular support. Artificial support may gradually give way to natural support. The paralytic scoliotic must receive a larger proportion of artificial support than will be required for those not paralyzed in the trunk muscles. Internal splinting, by operative bone-fixation, may also be necessary in severe paralytic cases.

CHRONIC CIRCUMSCRIBED OSTEOMYELITIS

BY DR. WALTER G. STERN, M. D., F. A. C. S., CLEVELAND, OHIO.

Influenced by a more attenuated form of infection, an unusually small bacterial embolus or by an unwonted resistance of the bones involved, a noticeable percentage of cases of osteomyelitis run a chronic and circumscribed course. The first period of invasion is quite as stormy as in any case of osteomyelitis, but the patients are not quite so septic as is ordinarily noted and instead of the process developing into a wide-spread necrosis with sequestrum formation, etc. in the usual manner when unoperated, the temperature goes down, the pain lessens and the oedema of the soft parts tends to disappear; the pain and disability and the bone and periosteal thickening alone remain more or less permanent. Apparent healing may even take place, lasting for years. (Case 1). In some cases there may occur periodic recrudescences with pain and fever (Case 2) and in other cases severe neuralgic pains persist for months and even years (Case 3).

The condition tends to become multiple and symmetrical, involving the other bones simultaneously or in succession (Case 4).

The most striking clinical feature of this form of osteomyelitis is the relatively enormous tumefaction and induration of the bone and periosteum, which forms around abscesses or necrotic areas which are usually situated in the metaphysis or in the ends of the diaphysis of the long bones. The abscesses can be multiple and each one is a center for symmetrical thickening. The abscesses may contain pus or seropurulent fluid.

The induration may be so circumscribed and develop so steadily, that suspicion of bone sarcoma may be aroused as in Case 5. In this case more careful examination revealed multiple lesions, while the radiographs showed areas of circumscribed necrosis within the center of the thickened bone.

In 1850 Sir Benjamin Brodie described a chronic abscess situated in the upper part of the tibia, characterized by a thickening of this portion of the tibia. Where the abscess formation has been the most prominent feature, these lesions are often called Brodie's abscesses. Keen holds that Brodie's abscesses are identical with the abscesses of chronic circumscribed osteomyelitis oc-

curring in the vicinity of the epiphyseal line of the long bones, especially the tibia, femur and humerus. It has been held by many observers that the typical Brodie's abscess is a form of tuberculosis of the shaft of the long bones and there are animal experiments to prove that given cases were indeed tuberculous. Whether Brodie meant to describe a tuberculous or a non-tuberculous process is not accurately known, but in the series of cases of chronic circumscribed osteomyelitis reported by Klemm and other writers and in the cases observed by the author, there can be no question of tuberculosis raised. All these cases were distinctly pyogenic blood infections and in all the usual pyogenic organisms were demonstrated. In all our own cases the tuberculin reactions were negative, and guinea pig injections, when made, were also negative for tuberculosis.

The radiographic appearances of these lesions are quite characteristic. There are one or more sharply marked, ovoid areas of bone necrosis, usually in the ends of the diaphysis of a long bone, especially of the tibia, surrounded by a greater or lesser amount of tumefaction. It is unlike the usual picture of irregular sequestrum and involucrum formation characteristic of the usual type of osteomyelitis. It is more sharply localized and produces less bone destruction and more bone over-production. The picture of the lesion is sharp and clear, never blurred, hazy, indistinct or "smokey."

Upon operation, the bony walls of the necrotic areas are often found eburnated and the cavities filled with pus, granular bony detritus, bone spicules, granulation tissue or even thick necrotic masses resembling brain substance. The walls are often lined with a dense, smooth, tough membrane which is difficult to scrape away. Sequestra, other than small bone spicules, are rare. No cysts or limiting cyst membranes will be found on pathological examination.

Chiselling away the walls, followed by a thorough curettage of the cavities with the removal of the dense lining membranes, followed by Mosetig bone wax or the Carrel-Dakin technic, is usually all that will be required to bring about a cure. When possible the usual fresh air and heliotherapy regime given to any case of chronic local infection should be used.

The diagnosis is at times exceedingly difficult and Kocher and his pathologist are on record as having mistaken cases for sar-

coma and made the diagnosis only by the clinical course of the disease. Klemm speaks of a case where the operative findings and the pathological pictures were identical with sarcoma, but the ultimate course showed it was a case of osteomyelitis.

The disease must be differentiated from tuberculosis, syphilis, sarcoma, chondroma, bone cyst, osteomyelitis hemorrhagica and Paget's Disease. The differentiation is exceedingly difficult and must be made from the clinical course of the disease, laboratory tests and X-Ray findings, altho the latter are rarely characteristic enough to be the sole determining factor. A leucocytosis is present only during active febrile stage.

The prognosis is, of course, much more favorable than in the usual type of osteomyelitis.

ILLUSTRATIVE CASES

Case 1. Boy age 16. At the age of 6 years received a fracture of the humerus; a few weeks later, ushered in with chills and fever, an infectious osteomyelitis of the upper part of the tibia developed and was the cause of an extensive bone operation, the details of which cannot be learned at this time. The wound was packed and remained open for a time, but finally healed before the age of 7 years. At this time a swelling of the internal malleolus was noticed but as it did not pain him it was not operated upon.

For the past 9 years the enlargement of the malleolus has persisted, until it has forced the foot into eversion. Patient comes for the relief of his "flat foot." Has pain only when he injures bone, never has had redness, swelling, fever or spontaneous pain.

The radiograph shows only thickened and eburnated bone. The lower end of the tibia is at least half again as thick as normal.

Operation revealed an adherent and smooth periosteum with dense bone beneath; no signs of periostitis. After chiselling thru at least one inch of dense bone, a cavity was opened up which was filled with granular tissue, inspissated pus and bone debris. Cavity walls smooth and covered with fibrous membrane, this was removed and cavity packed with Mosetic Bone Plug. Cultures showed a pure culture of Staph. Pyogenes Aureus.

Case 2. Boy age 12 has been suffering for the past three years from periodic attacks of pain, gnawing in character, in the upper part of the right tibia. The attacks have been accompanied with fever, at times chills and intense swelling of the soft parts which, however, soon subsided after the pain ameliorated. He averaged four to five attacks of this kind per year. The radiographic findings are said to have been negative except for a thickening of the bone, and a diagnosis of Milroy's Disease was made. When first seen by me the history of repeated attacks seemed to be the only puzzling feature in the case. Otherwise it looked like a mild attack of osteomyelitis. The radiographs taken at this time showed a small area of necrosis the size of an almond in the center of the upper part of the diaphasis of the right tibia, surrounded on all sides by thick eburnated bone. Upon operation the cavity was found to contain creamy pus with a pure culture of staphylococcus aureus. Guinea pig injections were negative for tuberculosis. The tuberculin reactions were also negative. Leucocytosis 9000. The operative wound healed in a few weeks and for four or five months thereafter the boy enjoyed perfect health with the disappearance of all symptoms. Then the symptoms suddenly made their re-appearance but this time the pain, swelling and bone thickening occurred on the opposite shin. Leucocytosis 19000. The X Ray revealed a similar abscess on the left tibia and a similar condition was shown at operation. This abscess too, made an uneventful operative recovery.

Case 3. Woman age 30. States that as long as she can remember she has had excruciating neuralgic pains in the right shin, radiating down into the ankle joint. The crest of the tibia has always been roughened and the limb has always been thicker than the opposite side. Never remembers to have had any illness with severe pain, high fever and chill. Except for a moderate degree of enlargement of the entire shaft of the right tibia, more marked in the lower third, and some roughness on the crest of this bone, the examination was absolutely negative. The X Rays showed eburnation and enlargement of the tibia; no necrotic areas were visible. The Wasserman and tuberculin tests were also negative, and the patient had nowhere else any evidence of Luetic or tuberculous infection. No leucocytosis. Upon operation it was found that the center of the tibia at the junction of the middle and lower thirds contained an abscess filled with extremely

thick, brain-like material, containing some bone sand and lined with thick fibrous wall. The cortex of the bone, which was at least an inch thick was chiselled away, the cavity membranes scraped out and the soft parts tucked into the cavity according to the methods described by Carl Beck of Chicago. The patient made an uneventful recovery.

Case 4. Girl age 10. Otherwise in good health was suddenly taken ill with chills and high fever and pain in the lower end of the right tibia. This part of the leg became red, swollen, oedematous and for two days the child was extremely ill. The symptoms, however, soon subsided leaving a thickened, indurated area on the lower part of the right shin. Patient unable to walk on account of pain in the ankle joint. After a few weeks, ushered in by chills and fever, the same process took place in the lower end of the opposite tibia. The symptoms again lasted only for two or three days. When the case was brought to my attention the child was pale, aenemic, evidently suffering from a chronic sepsis, unable to walk on account of pain in both ankle joints, and the lower thirds of both tibias were enlarged, swollen and painful. No leucocytosis. X Ray photographs showed three distinct areas of breaking down in the lower part of the right tibia and two circumscribed areas of similar nature in the left tibia; the entire diseased area was very much thickened and the bone was already denser than normal. On account of the multiple necrotic foci and the symmetry of the condition a tentative diagnosis of Leutic osteomyelitis was made. The patient, however, presented no other signs of active syphilis and the Wassermann test was repeatedly negative. The tuberculin tests were also negative. At the time of operation, after chiselling thru the eburnated cortex, three cavities in the right tibia and two cavities in the left tibia were found. These cavities were not connected with each other and were filled with seropurulent fluid; the cavities were smooth, the walls lined with a thick, glistening membrane. The entire diseased area was chiselled out and the wound, bone wound filled with Mosetig bone wax, the periosteum and skin were tightly sewn over the wax plug, and the child made an uneventful recovery. Bacteriological examination of the seropurulent fluid revealed a pus culture of a diplococcus, the exact nature of which has not yet been determined by the pathological laboratory. His-

tological examination of the cavities shows that they were of inflammatory nature and not cysts.

Case 5. Mary, girl age 6. Brought to the Dispensary at Mount Sinai Hospital on account of a rapidly growing tumor in the metacarpal bone of the index finger of the right hand. Is said never to have been ill, never to have had, within recent times, chills and fever, and the swelling of the hand is rather painless. The skin over the growth was seamed with enlarged veins and a tentative diagnosis of sarcoma was made. On admission to the hospital a much smaller tumor of the metacarpal of the index finger of the left hand and a fluctuating mass in the right calf were also found. The radiographs showed in both the metacarpals, an immense amount of thickening confined to the distal half of the bone so that this part was almost twice as large as the proximal half. In almost the exact center of the enlargement was a fair sized area of destruction, sharp in outline and in no way resembling the destruction from sarcoma or tuberculosis. The radiograph of the right tibia and fibula were negative.

Upon operation the above mentioned cavities in the metacarpals were found to contain thick yellowish pus from which a pure culture of staphylococcus aureus was grown.

The mass in the calf was an abscess outside of the periosteum and beneath the muscles. It also contained the same staphylococcus. Nowhere could any thickening of the periosteum or roughening of the posterior surface of the tibia be discovered. The bone cavities and abscess were treated according to the Carrel-Dakin technic, but the recovery has been slow and heliotherapy has been resorted to with apparent success. The tuberculin and Wassermann tests have repeatedly been negative.

OSTEOMYELITIS FOLLOWING WAR INJURIES

Based on the Study of 61 Cases.

BY RICHMOND STEPHENS, M. D. NEW YORK CITY

It is practically impossible to determine the number of bone injuries from the recent war which have gone on to a very chronic condition and are still not cured. We do know, however, that there is a large number and that many of them will require long and careful treatment.

The men who have been discharged from Government Service now receive treatment from the Government through the War Risk Insurance Bureau and this work is carried on by the Public Health Service. A few men probably receive treatment from other sources but by far the large majority take advantage of this opportunity for care. As we know, several hospitals have been established throughout the country by the Public Health Service. I have been fortunate enough to be connected with such an institution in New York City and it is upon the work done there that this paper is based.

The Orthopedic Service is called upon to examine, advise and treat all cases which come under its scope. However, some cases go to the General Surgical, Neurological, Physio-therapeutic or Out-Patient Departments and we have not been able to observe them, but we do see all those that require Bone operations, Plaster-of-Paris or Brace treatment. During the first five months of the service we treated 174 patients for the War Risk Insurance Bureau. Of this number 61 or approximately 35% of the cases were suffering from Osteomyelitis in its most chronic form.

These introductory remarks are made merely to give an idea of the frequency of osteomyelitis resulting from war wounds. The figures are accurate but of course we cannot make many definite deductions for we do not know what proportion of the resulting war disabilities come to our attention. I believe that we can realize that there are many men with this condition and more than one would think after knowing all of the work that has been done and the good results reported by so many men by various methods of treatment.

We must take it for granted that all of these cases of very chronic osteomyelitis were at least closed at the time the men were examined for discharge from War Service. Probably most of them were pronounced cured and many similar cases may have been cured but we know that in this series they were only temporarily arrested or closed.

From these and other experiences we must conclude that one can practically never pronounce a case cured. Some apparently are but others may merely be quiescent for a short time or for a very long period. We all know that some cases of osteomyelitis have run extremely long courses. I have had a case called to my attention that was healed and supposedly cured for ten years and then developed a sequestrum which had to be removed. It is not uncommon to see cases that have been active for a long period and I recently saw one that still had a sinus which had been discharging almost continuously for over 20 years.

In this series of cases 7 were from causes other than gunshot wounds. The remaining 54 were the result of wounds from bullets, shrapnel balls or explosive shells, and necessarily were inflicted from 10 to 21 months before these observations and the osteomyelitis was quiescent for a variable period up to one year.

It is fair to presume that these cases received average treatment before this time as they were practically all in different organizations, wounded in different periods of the war and treated at many different hospitals, both in France and in the United States after their return. It has been impossible to determine what type of treatment was instituted in each particular case but we do know that many had several forms at different times and that others had one of the various types throughout the entire period of the active lesion.

From the above facts, it seems right to proceed on the assumption that the series is really a very fair average as regards early treatment, period of disability, etc. As to the type and severity of the original injury and as to the bone or bones involved, the following table will show us that in these respects also, the series is a good one for study.

Number of War Cases Examined	174
Chronic Osteomyelitis	61
Percentage of Osteomyelitis	35%
Osteomyelitis from Bullet or Shell Wound	54
Time Since Injury—10 to 21 months	
Longest time closed—Less than 6 mo.	49
6 mo.	4
7 mo.	1
8 mo.	2
9 mo.	1
10 mo.	1
11 mo.	1
12 mo.	1
	61
Number of operations on each patient	1 to 8
Cavity present	14
Tunnel present (thru and thru)	5
Bone Fistula only	26
Superficial scar unhealed	6
Periosteoma	2
Trough (after operation)	4
Osteomyelitis and non-union	2
Foreign Bodies present	7
Definite sequestra present	32
Cases originally having complete fracture	32
Cases originally having incomplete fracture or bone wound	14
Amputation stump of Femur	8
Tibia	1
Humerus	1
Lesion in Femur	12
Tibia	9
Fibula	3
Humerus	8
Radius	1
Ulna	4
Scapula	3
Ilium	2
Sacrum	1
Ribs	1
Ankle and Foot	4
Wrist and Hand	3

The presence of "thru and thru" tunnels, cavities or simple fistulae probably depended on the extent of the original injury and the very early treatment. (See Plate 1).

In 6 cases it was stated that the superficial scar was unhealed and in all of these the presence of bone disease could not be demonstrated but the surface scar apparently broke down very easily from mild trauma or possibly from a still present but low-grade infection.

The periosteoma in each of the 2 cases noted was a definite fungus-like outgrowth from the periosteal surface of the femur. One was a case of simple fracture that became infected after a

plating operation (more than a year before) and the other was an osteomyelitis from a severe contusion. In the latter case there was a tunnel thru the outgrowth and after supposedly complete removal a recurrence about the size and with a similar tunnel was seen. It would seem that some of the periosteum with attached bone cells must have been left at operation. Rocher has described this condition under the name of Traumatic Periosteoma and considers it due to a contusion or a grazing wound of the periosteum resulting in a fungous-like bony growth with a sinus in which bone can be felt with a probe. He claims that very careful complete removal is necessary for a cure.

In the 4 cases listed as having a trough, the X-ray examination showed that radical bone operations had been done and that the cavities had been very well obliterated. (See Plate 2). In

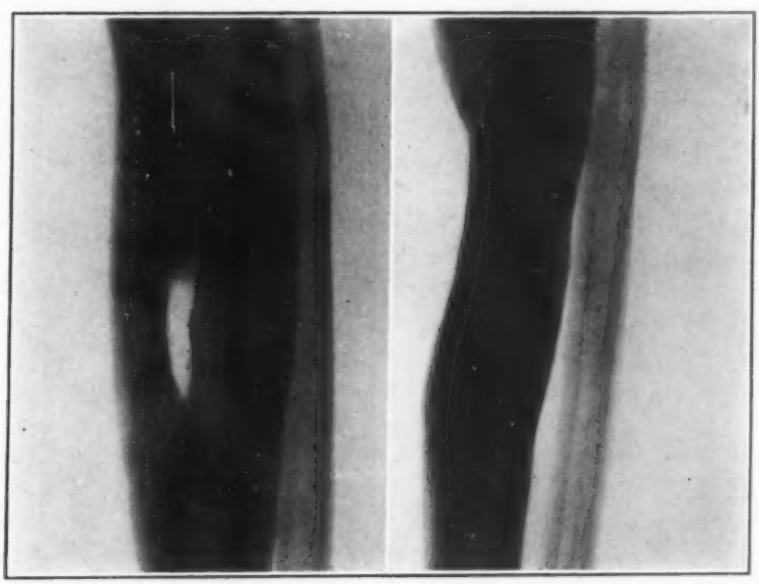


PLATE 1.

A case of thru and thru tunnel in the tibia as seen in a lateral view. No evidence of disease. Many small foreign bodies present. There was a sinus which closed a few days after admission and remained closed during the two months that the patient was under observation.

PLATE 2.

A case showing a shallow trough in the tibia which was made at a previous operation. There was a superficial wound which closed without operative treatment.

one of these cases there was a sequestrum present which had to be removed.

The two cases of non-union with disease were both of the ulna and are merely being observed until a later date for bone-graft operations. (See Plate 3).

It was noted that 7 cases showed foreign bodies present but it was only in two that they apparently caused prolongation of the lesion. In all the cases the foreign bodies were shell fragments.

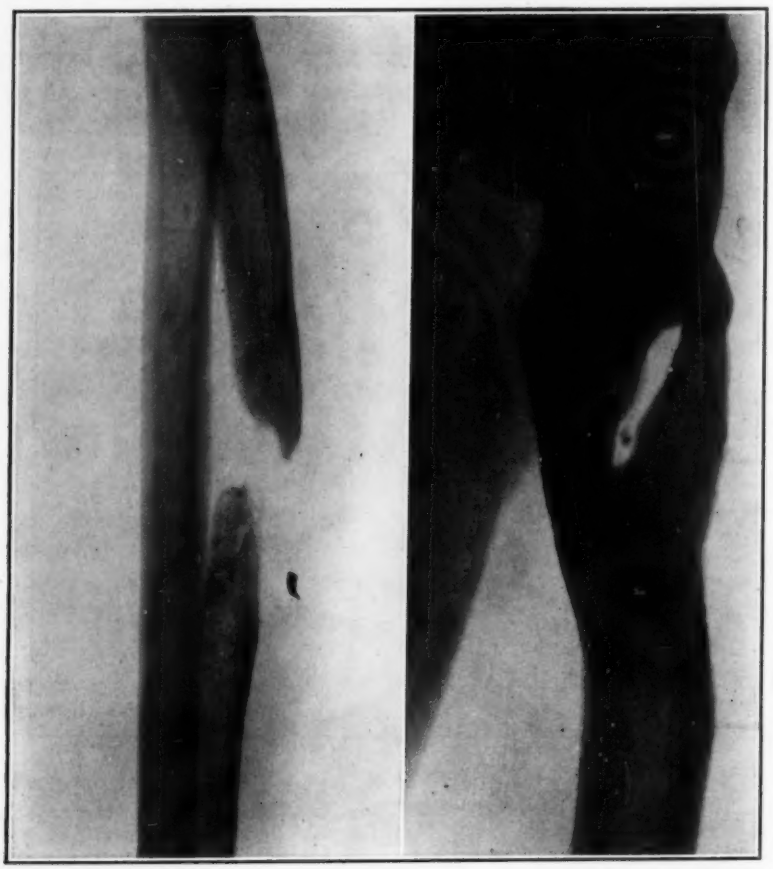


PLATE 3.

Non-union of ulna wih loss of substance, a foreign body still present and some disease in the end of the lower fragment.

PLATE 4.

A small sequestrum present in a tunnel in the humerus. The wound closed a few days after its removal. Four weeks later the patient fell and fractured both of the tunnel walls.

Sequestra were found in approximately half of the cases and did not seem to occur more often in any one bone than in another. I have not very exact figures as to how many of the cases gave a history of spontaneous discharge of one or more sequestra but it was a large proportion. (See Plate 4).

In 5 of the amputation stumps there was spur formation but this same condition was seen in a similar number of stumps that were observed which did not have any bone disease, so I infer that there is no connection between disease and spurs of this type.

The aims in the treatment of compound fractures and bone wounds at the time of injury are as follows:

1. Removal of foreign bodies, free and mobile bone fragments.
2. Obliteration of dead spaces.
3. Prevention or removal of infection.
4. Efficient reduction, splinting, etc., as indicated.

Undoubtedly, most of the cases that we see now could have been prevented had all of these aims been achieved. It is impossible to know in some of the cases which of the points in the treatment were at fault. Many of the cases were, of course, treated under circumstances which were far from ideal.

At a somewhat later stage when the osteomyelitis becomes chronic the problem is then somewhat the same, namely the removal of remaining foreign bodies, sequestra and infection, and the obliteration of cavities, tunnels and fistulae. Here we must open the bone wide or we will again have sequestrum formation because there is thrombosis of the nutrient vessels, exudate and necrosis, followed by osteo-sclerosis and persistent civity even if the sequestra does get out. There may not be a sequestrum if the infection is mild and then the necrotic bone may be replaced by new bone thus forming a cavity with hard walls incapable of filling-in by regeneration.

The real chronic stage with which we are dealing is somewhat different and considerably more difficult to cure. The pathological condition is much the same but with the addition in most cases of extensive osteo-sclerosis. Dehelly and Loewy lay particular stress upon the necessity of effacement of cavities, especially in fractures. They conclude that if this is done immediately after the wound or during the period of acute infection or

when consolidation has occurred it will not be necessary in the late or fistula period. The earlier it is done the better the opportunity to clean up the infection and the less chance of sequestrum formation, spread of infection and large cavity formation.

The removal of fragments may be controlled by X-ray and it is best to remove all free and mobile adherent fragments and detached periosteum. Removal of too little prevents disinfection but on the other hand the removal of too much increases the chances of pseudarthrosis.

In the type of chronic osteomyelitis of idiopathic origin or from trauma which does not cause an open wound, the infection is more liable to spread as there is no outlet and hence it does not become walled-off. In this fistula type the infection is said to be very superficial by Chutro because of the presence of the outlet and also a so-called lymphatic blockade. Others claim that it is often very deep and may even extend several inches from the surface.

The dense osteo-sclerotic bone formed about a cavity or tract presumably helps in preventing the spread of infection and it would therefore be unwise to remove it, but on the other hand if we hope to get good blood supply, new bone production and conversion of the cavity into a trough, it is certainly essential to take it away. In children bone evolution is not complete and we may see a remarkable growth f bone to fill a cavity or as replacement after a sub-periosteal resection. In adults a cavity will often be filled with fungosities which can wall off the infection and keep it superficial but cannot obliterate the space. If there is mild infection before the stage of osteo-sclerosis it acts as a stimulant to bone production and filling-in of the cavity may occur. If the sclerotic tissue is already present we may simulate the former condition by removing it.

In passing I would like to mention a case in this series which came in with an acute infection under a scar and from which a sequestrum was removed. It was in the upper end of the humerus and X-ray showed a complete tunnel thru the bone. The wound healed very rapidly and four weeks later the patient fell on the ice, striking his shoulder and he returned to us immediately with a simple fracture thru both of the lateral tunnel walls.

There was no displacement and in six weeks he had firm union. The interesting features of the case were that there was pain, crepitus and false motion but no evidence of swelling, ecchymosis or other local reaction. (See Plates 4 and 5). A similar case also came in with a simple fracture of the tibia at the site of an old compound fracture with osteomyelitis. There was loss of substance of about an inch-and-a-half but this defect had been filled in by a bridge of new bone approximately one-half the size of the tibia normally. (See Plates 6 and 7). The symptoms and signs were the same as in the other case and I believe that the absence of local reaction was due to the great amount of scar tissue and sclerotic bone at the site. It was interesting to note that this amount of trauma did not cause a recurrence of active disease, and that union occurred in a reasonably short time.

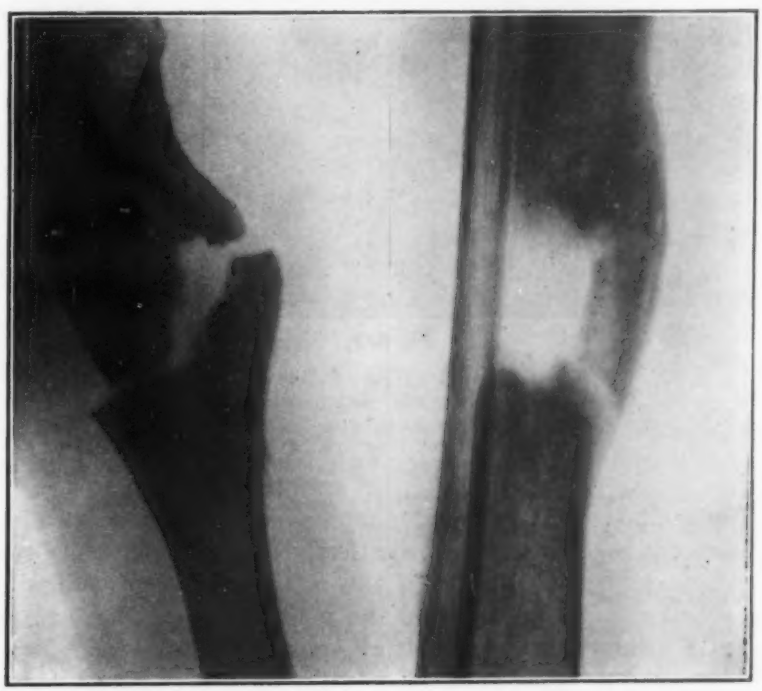


PLATE 5.

Same patient as Plate 4 showing the fracture thru the tunnel walls which was caused by a fall four weeks after the wound closed. Union was firm in six weeks.

PLATE 6.

Antero-posterior view showing a simple fracture from a mild trauma thru newly formed bone which had bridged a gap in the tibia.

In a femur stump which I re-amputated the entire end of the bone was soft and it was easily removed with bone-cutting forceps. There was no sclerotic bone and no sequestrum but merely a superficial necrosis. Primary post-operative healing occurred rapidly.

In flat bones, such as the scapula and ilium, a hole thru the bone is not in itself a bad condition as the soft parts on either side fall in and do not leave any dead space.

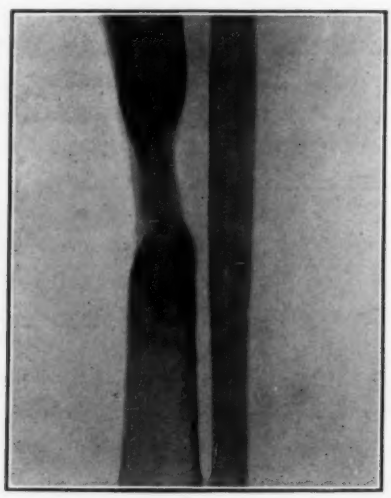


PLATE 7.

Lateral view of same case as Plate 6 showing how the inch and a half of lost substance had been replaced by new bone. The fracture is not well seen in this view.

The methods of treatment that have been tried are almost too numerous to mention but practically all have the same result in view, namely; the removal of the infection and any remaining foreign bodies or sequestra and the obliteration of the bone cavity with a filling-in of the resulting space. Often merely incision and drainage or removal of a sequestrum is sufficient. Sometimes curetting or attempts to sterilize the field and remove all affected bone and soft parts.

To obliterate a tract or cavity one may merely remove the edges and underlying bone and convert the defect into a saucer-

like shallow depression or trough. If there is a tunnel one of the walls may be removed, usually the weakest or the most accessible one. Some of the methods that have been used to fill in the remaining defect are, to cut bone wedges from the sides of the opening and force them down in with some pressure, free tissue transplantation, (usually fat) tissue flaps attached by a pedicle and in this type muscle has been found best. Such a flap has also been used in cavities near the ends of long bones and in tunnels.

From previous experience I have noted that the transplantation of free fat has failed in every instance. Experience with attached muscle pedicle flaps has been much more satisfactory. Theoretically this should be the best tissue available as it is so often present in sufficient quantity near the wound, is about the most resistant tissue to infection and it has very good blood supply. Gallie has reported some cases where he has had an opportunity in later operations to observe some of these flaps and he has found them fixed in place and united to the bone by connective tissue with the bone cavity remaining as it was at the former operation but surrounded by dense sclerotic bone.

Another method described but chiefly for non-traumatic chronic osteomyelitis is to remove just enough involucrum to get out the sequestrum and then crush down the rest of it to fill the cavity and pour in 3½% tincture of iodine once a week. The filling-in of a cavity with bone chips is somewhat the same in principle. Also merely allowing the overlying soft parts to fall in or be held in by firm dressings. Others by packing the wound to get healing-in by granulations from the bottom. Still others by skin flap methods to completely line the surface of the depression or wound. I have seen a case recently which was a failure following a skin flap operation where the skin had been nailed to the bone surface. These skin methods should be avoided because we see so many cases where there is later trouble from adherent scars which frequently break down, especially from trauma often of the mildest character.

The sterile blood-clot method has been tried and good results claimed but not in very large numbers. In some cases the wound has been closed immediately with or without drainage or after a few days of treatment with various chemicals, etc.

A method of trepaning has been tried by Soresi but so far we know very little about it. He drills many small holes in the

bone overlying a cavity and believes that the drainage is improved, the bone not materially weakened and that there is a better opportunity for granulations to grow in.

The polyvalent serum of Leclainche and Vallee has been used in the form of serumized dressings to pack the wound but the results are not reported to be very gratifying as the cicatrization is not durable and there is danger of lymphangitis, erysipelas and suppuration.

The use of various antiseptics has been unsatisfactory for when one is employed that is strong enough to wipe out the infection it will cause tissue necrosis and the likelihood of new sequestrum formation, etc., thus going again thru all of the stages of osteomyelitis.

Paste, wax, and similar materials have been tried very extensively and there are still many men claiming excellent results altho the majority report otherwise. It would seem that their use is limited and that in many cases the material might merely act as a foreign body. They are used a great deal along with operative treatment and the good results obtained may be due to the latter.

Light, both sunlight and artificial, has been used and in many cases has undoubtedly been of great benefit. My experience in this method is very limited but I have seen a few very chronic sinuses close during its use.

X-ray control of the cases is of the greatest value before, during and after treatment.

Subperiosteal resection may occasionally be indicated in the upper extremity where length is not of so much importance. It is not as good in adults as it would be in children, (where bone evolution is still incomplete) and often it will be necessary to follow it with a bone-graft.

In cases of bone disease in amputation stumps a cure may be effected by simple removal of a foreign body or sequestrum and curetting but occasionally a re-amputation is necessary and may give an excellent result but should not be advocated if the shortening of the stump will affect the application of a satisfactory prothesis.

I feel certain that we all agree that in these extremely chronic cases, surgical operation is the real treatment. In most of them

it is indicated alone but possibly in a few some one of the other methods may be used in conjunction with it.

These cases have not, of course, been observed for a long enough time to deduce any conclusions as to results. However, I wish merely to mention in passing that on the last examination the following tabulation was made:

Closed	40
Condition same (not op.)	8
Apparently need further treatment	6
Too soon after operation for report	7
	61

In the longest cases this only means about 5 months so it is needless to say that any of the cases can be considered cured.

The tendency in the treatment of all of the cases was conservatism. If from the history, examination and X-ray findings, a case was apparently improving it was observed for a while and I attempted to aid nature in closing it by simple dressings, rest of the part and in some cases massage and other physio-therapeutic measures when indicated.

In a few cases, incision and drainage of an acute flare-up with removal of any foreign body or sequestrum, followed by simple dressings was sufficient. In some this was done along with a gentle curettment. In others with acute infection present they were merely opened and drained and after several days when the acute signs cleared up the real operation was performed, namely; sequestrectomy and cavity obliteration.

When a definite cavity, tunnel or bone fistula was found, the defect was converted into a shallow trough and closure was aimed at by approximation of the overlying soft parts. There were no cases in the series where a flap was necessary but had there been I surely would have used an attached pedicle muscle and fascia flap, for the results in previous cases fully warranted such a procedure. When a tunnel or cavity is present near or at the epiphysis and hence in the region of a joint it is usually necessary to employ a flap, except, of course, cases where the joint has been completely obliterated.

In most instances the wound was closed in layers with a rubber tube drain to its deepest point and unless infection developed this was removed in two days. If there was evidence of much in-

fection present the wounds were left open and treated by the Carrel-Dakin method.

Some cases did not entirely close because they were allowed to get up too soon but when they were put back in bed the healing went on rapidly. A few very sluggish superficial wounds would not seem to close at all until they were strapped with adhesive plaster the same as is done in certain ulcers. It was routine in all cases to excise sinuses and as much of the scar tissue as possible especially when the wound was being closed at the same time. Also when there was an adherent scar or one that broke down readily or failed to heal, or when there was merely a tract in the soft parts not extending down to bone.

Three of the patients listed as requiring further treatment had been operated upon previous to our service and the operation in each case was a very extensive one on the upper end of the femur. In one there was definite sequestrum, one had many fragments of shell still present and the third had apparently an extension of the necrosis. These three patients had been operated upon by Dr. Chutro more than 6 months before I made the above notes on their condition. There was a fourth case of the same type which I included in the number of cases closed, but it did not look any too well at this time as there was a large scar adherent to bone and considerable tenderness, redness and infiltration.

The other three apparent failures were as follows: One had a sequestrum apparently not found at operation, one had a periosteoma recurrence as I have mentioned before (See Plate 5) and the third had a new sequestrum develop later. This last condition might have been expected for at the original operation I removed a few small sequestra and one very large piece of necrotic bone which was still attached at one end.

In all of the cases physiotherapy has been used whenever possible. It is certain that it has shortened the period of disability in most cases by keeping up the tone of the muscles and preventing loss of function or even improving function in neighboring joints.

I feel that a word must be said about occupational therapy and recreation. We all know what these mean in most any orthopedic condition where the course is chronic. The men with

whom we have been dealing are all Ex-Service men and they have all been thru many hardships, long periods of disability and confinement in hospitals and are anxious to get back to their regular lives. It is most essential to keep them busy and happy and satisfied, and I am sure that everyone who has worked with them will agree that they are most willing to co-operate and this is, of course, an important and necessary feature.

It is needless to mention before closing that nothing new or original is claimed in the treatment of this condition, but I consider that it is such a large and important subject that a great deal of stress should be laid upon it and that it is well to keep it as an open book before us. Also the report of the observations and study in such an interesting series of cases should not be passed by without note.

I do wish to repeat that I believe conservatism is the keynote in the treatment and from the observation of these cases it has been very emphatically shown that the results in the cases which have had very radical treatment are no better than in those which have had the form of treatment employed in this series. Also that those treated by radical methods often have late developments of serious character such as non-regeneration of bone, increased liability of fracture, etc. Many reports have been made on early cases of chronic osteomyelitis but comparatively few on this extremely chronic fistulous type. I think that we are all going to have the opportunity to study cases of this character for some time and that if all the results will be recorded we may arrive at some more definite conclusions and probably find the ideal treatment or at least emphasize the importance of avoiding many of the harmful radical procedures that have been tried and found wanting. Never before has there been an opportunity to observe this condition in such a large number of cases as have resulted from the War and, of course, these have not been followed for a very long time. I feel sure that everyone will have the same experience that I have and will see many of the cases that have been reported cured, return with further trouble.

CONCLUSIONS

1. Chronic Osteomyelitis is seen in a seriously large number of patients who have had bone injuries.

2. It is extremely chronic in its course and it is practically impossible to determine when a case is cured as some may light-up many years after they have been considered finished.

3. Efficient early treatment would lessen the chances of this chronic condition or possibly entirely prevent it.

4. That the methods tried in the real chronic stage are not very satisfactory, is evidenced by the large number and the variable results claimed, and the fact that we still see so many uncured cases.

5. Operative treatment is indicated in practically all of the cases.

6. The aims in the treatment are:

(a) To remove any remaining foreign bodies, sequestra, etc.

(b) To remove the infection.

(c) To obliterate the cavity.

(d) To fill in the space.

7. The space is filled most satisfactorily by the overlying soft parts if the trough can be made in a situation where plenty of tissue is available. If flaps are necessary muscle has been found best.

8. Conservative treatment rather than radical should be employed.

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A PROTRACTOR FOR MEASURING ROTATION OF JOINTS

WILLIAM ARTHUR CLARK, A. M., M. D. PASADENA, CALIFORNIA

This instrument is a half circle cut out of zinc, aluminum or other rigid material, marked with the degrees of the half circle arc from 0° to 180° and mounted on two upright pieces so that it is vertically adjustable. It is made large enough to go over the knee which is the largest part it is required to arch over. By means of the vertical adjustment it is set at the desired height above the flat surface upon which the limb rests so that the diameter from 0° to 180° passes at right angles through the axis

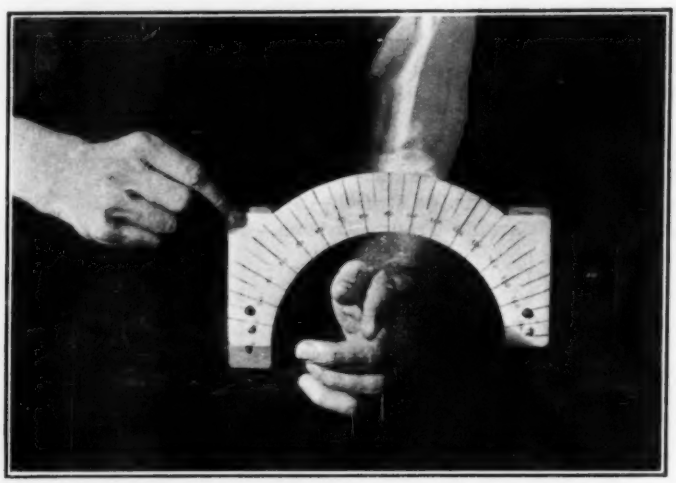

FIG. 1. Neutral position of the forearm, (90°). For use on the right arm or leg, reverse the protractor and read from the proximal side.

of rotation. The zero end of the arc is placed toward the median body line so that inward rotation is always toward 0° and outward rotation toward 180°. In stating the amount of rotation it is not necessary to specify internal or external but merely to state the two limits, e. g., rotation 40° to 160°. This is one of the details of a system of joint measurements described in a previous paper.[1]

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[1]Clark, William Arthur. A System of Joint Measurements. The Journal of Orthopedic Surgery. 2:687, December, 1920.

*The photographs were made by the photographic studio of the Mayo Clinic.

The reading is taken by sighting along the radiating lines on the wide surface of the protractor, the observer's head being placed so that the eye comes almost in the same plane as the protractor and at sufficient distance to lend perspective. By moving the head a radiating line will be found which coincides with the plane of the rotated limb. (90° in Fig. 1) For the forearm this plane is that which passes through the radial and ulnar

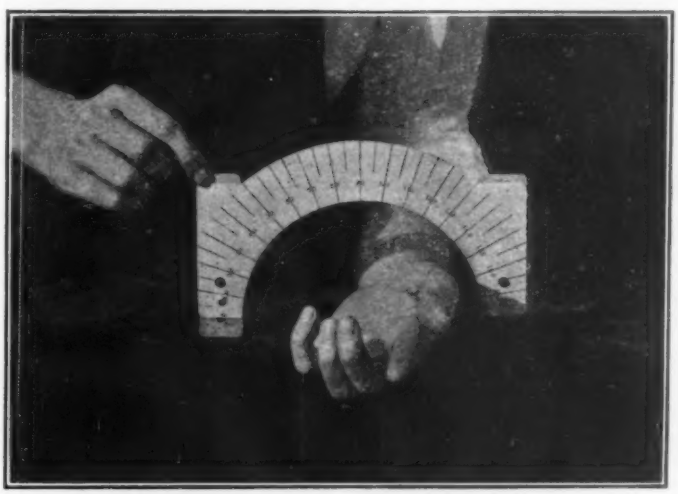

FIG. 2. Rotation (supination) to 165°. By loosening the upper screws on either side the protractor can be moved up or down on its supports.

styloids. For all other parts it is the antero-posterior plane. It is necessary to make this exception for the forearm because the anterior projection of the antero-posterior plane would pass out of the half circle on complete pronation. Also because the axis of rotation of the radius does not coincide with the long axis of that bone but passes through the lower end of the ulna and the head of the radius.

GIANT-CELL TUMOR IN THE KNEE JOINT: REPORT OF A CASE

BY PIO BLANCO, M. D.

FELLOW IN ORTHOPAEDIC SURGERY, THE MAYO FOUNDATION, ROCHESTER, MINNESOTA.

Case A339505. Mrs. P. B., aged 30, came to the clinic in November, 1920 complaining of a swollen and painful left knee of one year's standing. Four years before she had sustained an injury to both knees from a fall. There was no immediate disability, but a small tumor appeared on the left knee and gradually attained a diameter of 4 cm. There had been no locking, swelling or local tenderness of the joint at any time, and it was painful only if used.

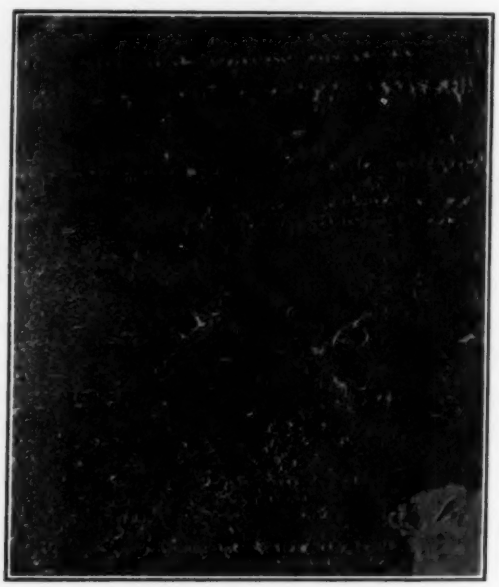

FIG. 1. CASE 339505. Low power photomicrograph of giant-cell tumor.

Examination revealed a healthy young woman, 5 feet, 5.5 inches tall and weighing 167 pounds. Her blood pressure, pulse, and temperature were normal. There was no leukocytosis and the Wassermann reaction of the blood was negative. A roent-

genogram of the left knee was negative. The smooth, round, movable, firm tumor could be felt on the outer side of the ligamentum patellae. Motions of the knee joint were normal.

November 9, 1920, Dr. M. S. Henderson removed the tumor which was lying in the capsule of the joint and was intimately associated with the infrapatellar pad. An area of discoloration in the tumor suggested the presence of a fairly recent hemorrhage. Microscopic study of the tissue revealed giant-cell tumor of the xanthic type. The patient's convalescence was uneventful.

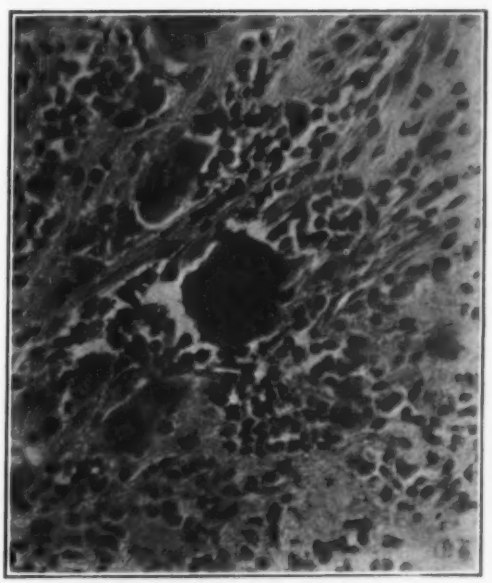

FIG. 2. CASE 339505. High power photomicrograph showing the structure of the giant cell.

DISCUSSION

The pathologic changes observed in the tumor are analogous to those found in the xanthic giant-cell tumors reported by Broders. Figure 1 is a low power photomicrograph of the tissue and Figure 2 shows the structure of the foreign-body giant cell highly magnified. Broders has reviewed the literature of this type of tumor and has reported a series of seventeen cases observed in the Mayo Clinic. These tumors are benign and may be considered a type of granulation-tissue tumor resulting from hemorrhage. The hemorrhage may be caused either by infection or trauma. The polynuclear giant cells observed morphologically resemble the osteoclast and their function is probably phagocytic. As a rule these tumors are located on the extremities and are commonly associated with a tendon or its sheath. Not to my knowledge has their presence in the joints been reported.

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Arthur J. Gillette 3d.

Died at St. Paul, Minnesota, March 23, 1921.

ARTHUR J. GILLETTE

On March 24th I received the following telegram:

Arthur J. Gillette passed away last night.
Katherine Gillette.

Just four weeks before he wrote me: "I am in better health than I have ever been and am not going away this winter."

What the physician's diagnosis was I do not know. It does not matter. He really died from over-work and untiring devotion to his patients and his family.

A few years ago his vision became dim from high blood-pressure. His physician commanded complete rest. He went away for a little while and then returned, and thought he was taking things very easily when in reality he was working harder than any of the rest of us when we are busy. For more than 20 years he has treated more pay patients daily than any two orthopedic surgeons of whom I know.

In 1889 he came to New York and served for a year as Resident Surgeon of the New York Orthopedic Dispensary and Hospital. He was a charter member of the American Orthopedic Association. He was responsible for the establishment of the first State care of cripples, which culminated in the Minnesota State Hospital for Crippled and Deformed Children of which he was the Chief Surgeon from the beginning of the work until his death. For a quarter of a century he was the leading orthopedic surgeon of the Northwest. He was an essentially conservative surgeon; nevertheless he was among the first to operate for ununited fracture of the neck of the femur. The keynote of all his work was good sense. He dealt in facts, and had no time for dreams, and no patience with shams.

Arthur Gillette was a real man; and I am proud to say that he was my friend for 32 years.

JOHN RIDLON.

ARTHUR J. GILLETTE

In the death of Dr. Arthur J. Gillette, Minnesota and the Northwest have suffered a great and enduring loss. He was a pioneer in the field of Orthopedic Surgery and when that specialty was still in its infancy he brought Minnesota to the front rank in this field. He caused Minnesota to see, appreciate and attack the problem of the crippled child a long time before most of the states realized that such a problem even existed. As a result—there stands today the model Institution at Phalen Park—a monument to its founder and a dispenser of past, present and future blessings the value of which can never be measured in terms of money alone.

It is unnecessary to write of Arthur Gillette's prominence in the field of Orthopedic Surgery; of the many honors bestowed upon him by the associations of which he was listed a member; of his numerous and able contributions to the literature of his specialty. All of that is a matter of record and is well-known.

In him there passed away a man; a real and lovable man. He was of unexampled buoyancy and good cheer which radiated from him and contributed not a little to his great professional success. He was of wide culture and interested in many of the fine things of life outside of his profession. To the younger members of his profession he was always a wise and honest counselor and a good friend. He excelled as a teacher; his enthusiasm was contagious. His lectures were masterpieces because he was a master of his subject. Those who knew him best loved him most.

EMIL S. GEIST.

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NOTES AND NEWS

Dr. C. F. Painter of Boston, who has been Dean of Tufts Medical School for some years, has resigned. Dr. Painter will continue his duties in Tufts as Professor of Orthopaedic Surgery.

Dr. Richmond Stephens of New York has announced the removal of his office to 119 West 58th Street.

AMERICAN ORTHOPEDIC ASSOCIATION

Annual 35th Session

Boston, Mass., June 2, 3, 4 and 6, 1921

PRELIMINARY PROGRAMME

THURSDAY

June 2, 1921

9:00 A. M.	**Presidential Address.** Dr. Robert B. Osgood.
9:30-11:00	**Congenital Hip Commission Report.** Drs. Goldthwait, Adams and Willard. **Discussion** to be opened by Dr. E. H. Bradford and Dr. H. L. Taylor.
11:00-11:30	**Congenital Dislocation of the Hip.** Dr. John Ridlon.
11:30-12:00	**Arthroplasty.** Dr. Vittorio Putti.
12:00	**Executive Session.**
1:00-2:00	**Luncheon.**
2:00-2:30	**Cancer.** Dr. R. B. Greenough.
2:30-2:50	**Infantile Paralysis.** Dr. R. W. Lovett.
2:50-3:20	**A Clinical and Experimental Study of the Application of Free Transplants of Fascia and Tendon in Orthopedic Surgery.** Dr. W. E. Gallie and Dr. A. B. LeMesurier.
3:20-3:40	**End Results in the Operative Procedures for Infantile Paralysis with Special Reference to Tendon Transplantation at the Widener Industrial Training School for Crippled Children.** Dr. A. Bruce Gill.
3:40-4:00	**Some Views on the Immobilization Treatment of Septic Arthritis of the Knee.** Dr. F. R. Ober.
4:00-5:00	**The Teaching of Orthopedic Surgery.** Dr. Nathaniel Allison.

EVENING SESSION—8:00 P. M.

Ten-Minute Addresses

A Historical Review of Surgical Methods in the Treatment of Spine Injuries. Dr. H. W. Orr.

Amyotonia Congenita of Oppenhiem with Case Report. Dr. Charles A. Stone.

Lengthening of the Quadriceps Tendon for Mobility of the Knee Joint—End Results and Moving Pictures. Dr. G. E. Bennett.

Treatment of Fractures of the Femur. Dr. Frank E. Peckham.

Sympathetic Segmental Disturbances, or the Association of Visceral Diseases with Minor Spinal Curvatures of the same Sympathetic Segments. Dr. Henry Winsor.

Abstract:

After the examination of fifty animals and fifty human skeletons, minor curvatures of the spine were observed in the majority; after summarizing the results of fifty necropsies, visceral diseases were found to be secondary to minor curvatures of the vertebral column, sympathetic irritation causing vaso-motor spasm of the organs, the ischemia thus produced resulting in a predisposing factor of disease. Temporary curvatures produced in the spines of cats caused collapse of the great vessels and diminution of cardiac movement. Dissections of the sympathetic showed that movement of the spine causes stretching and relaxation of the sympathetic.

FRIDAY

June 3, 1921

9:00-10:00	**Sur un nouveau traitement de la paraplegie Pottique. Sur l'osteo-chondrite infantile de la hanche. (Maladie de Legg-Calve.)** Dr. Jacques Calve.
10:00-11:30	**Commission Report on Ankylosing Operation on the Spine.** Drs. Brackett, Rugh, Baer.
11:30-11:50	**Army Experiences with Tendon Transferences—End Results.** Dr. Clarence L. Starr.
11:50-12:10	**Operative Treatment and End Results in Disabilities of the Arm and Shoulder.** Dr. Arthur Steindler.
12:10-12:30	**Arthroplasties—End Results.** Dr. W. S. Baer.
12:30-12:50	**Arthroplasty of the Knee—Report of Cases.** Dr. W. C. Campbell.
1:00-2:00	**Luncheon.**

Symposium on Fractures

2:00-2:30	**End Results in Fractures of the Hip.—Fracture Service.** M. G. H. Dr. D. F. Jones and Associates.
2:30-3:00	**Fractures of the Elbow in Children.** Dr. J. S. Stone.
3:00-3:30	**Bone and Joint Fractures—Knee and Ankle.** Dr. G. W. Hawley.
3:30-4:00	**End Result Fractures—Lower Leg.** Dr. E. W. Ryerson.
4:00-4:30	**End Result Fractures—Femur.** Dr. M. S. Henderson.
4:30-5:00	**Operative Treatment of Epiphyseal Separation.** Dr. David Silver.

SATURDAY

June 4, 1921

9:00-10:30	**Commission on Stabilizing Operations upon the Foot.** Drs. Cook, Fitch and Stern.
10:30-10:50	**The Stabilization of Paralytic Feet.** Lantern Slides. Dr. Michael Hoke.
10:50-11:05	**Report of Results of Cuneiform Osteotomy of the Neck of the Astragalus in Paralytic Talipes Equino Valgus, and Varus Plus Pes Cavus.** Dr. Compton Reilly.
11:05-11:20	**Congenital Club Feet (General and Present Methods in the Treatment of).** Dr. Eben W. Fiske.
11:20-11:40	**The Treatment of Sprain—Fracture of the Tubercle of the Tibia in Adolesence (Osgood-Schlatter Disease).** Lantern Slides. Dr. Robert E. Soule.
11:40-12:00	**Peripheral Nerve Injuries.** Dr. Harry Platt.
12:00	**Executive Session.**
P. M.	**Canton.** Massachusetts Hospital School for Crippled and Deformed Children.

MONDAY

June 6, 1921

A Clinical Day is being arranged, but the details will not be available before the final program is issued. It will be necessary for any who have secured reservations at hotels from the 2d to the 5th of June and desire to

stay through the sixth to secure such additional reservation through the Hotel Committee of the American Medical Association. It can not be done through communication with the hotel direct. This committee can be reached by addressing the Committee of Arrangements at 8 The Fenway, Boston.

Papers Submitted

And to be Read by Title

The Pathology of Two Unusual Cases of Contracture. Dr. Sydney M. Cone.

A Report of Three Cases of Avulsion or Fracture of the Lesser Trochanter. Dr. C. F. Eikenbary.

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Astragalectomy and Backward Displacement of the Foot. An Investigation of Its Practical Results. Dr. A. Whitman.

Early Weight Bearing in Amputations of the Lower Limb. Dr. P. D. Wilson.

Current Orthopaedic Literature

Delay of Healing of Fractures and the Influence of War Nutrition. U. Hammer. *D. m. W.* 1920. 27. S. 728-40.

The retardation of callus formation has been noticed in a considerable number of cases. No definite local and constitutional causes could be determined except undernourishment with its resultant latent damage to the skeleton. The damage does not express itself symptomatically or roentgenologically but manifests itself only as soon as bone is called upon to form callus in the healing of fractures.

The author concludes that this phenomenon is explainable by the deficient feeding of war. As treatment he recommends hot air, massage and mechanotherapy locally and calcium and phosphorus preparations internally, but expresses doubt as to the efficiency of this treatment.—*A. Gottlieb, M. D., San Francisco, Calif.*

Quadriceps Atrophy. Arthur Stoffel. *D. m. W.* 1921. 5. S. 126.

This common and troublesome affection is overlooked and disregarded very frequently although it leads to marked functional disability. The author reports four cases and draws attention to its importance. The primary factor may be a slight injury or insignificant infection of the knee joint; the atrophy sets in as early as one week after it and lasts many years after the primary cause has been abolished. This atrophy is very troublesome and obstinate to treatment. The actual causation of this phenomenon, the quadriceps atrophy, still requires explanation; inactivity alone cannot account for it since it does not occur in other muscles except, in rare occasions, in the deltoid. The author advocates faradisation, massage and mechanotherapy as treatment. Detailed reports of four cases follows.—*A. Gottlieb, M. D., San Francisco, Calif.*

Comparative Frequency of Dental Caries Among the Tuberculous. P. Fargin Fayolle, *Presse Medicalt*, Jan. 15, 1921.

Fayolle points out the importance of taking into account the decalcifying tendency that goes with active tuberculosis.

He made a study of a series of patients and found the percentage of tooth damage to be 33 in the tuberculous as against 28 and 20 in general medical and surgical cases.

BONE GRAFTING: STUDY OF A SERIES OF CASES OPERATED IN U. S. ARMY HOSPITALS. By Dr. J. B. Walker, New York City, N. Y. *Annals of Surgery*, Jan. 1921.

The bones involved were:

	Grafts	Plates	Kangaroo Tendon	Wire
Humerus	118	19	13	14
Radius	161	5	4	8
Ulna	105	8	7	....
Radius and Ulna	54	11	3	3
Femur	46	87	12	10
Tibia	77	34	7	14
Fibula	9	....	....	....
Tibia and Fibula	41	25	6	5

In order to obtain the best results sufficient time must be allowed to elapse between the injury and the operation for the complete subsidence of the original infection, and the above figures show a more favorable recovery has followed the late rather than the early operation; that is to say, over rather than under two hundred days after injury. It is reasonably safe to operate during the fourth month after complete healing has occurred.

Grafts, autogenous, taken from the tibia have proved the most efficient material for bone grafting for fractures of the long bones, on account of its characteristic strength. They are best made with the saw and exact coaptation of parts of the graft to respective parts of the host bone must be secured.

While many of these records are as yet too incomplete to give the final end-results, yet sufficient evidence has been secured to prove that bone grafting is the most efficient method for non-union of fractures and very favorable results can be obtained in the largest percentage of cases.